



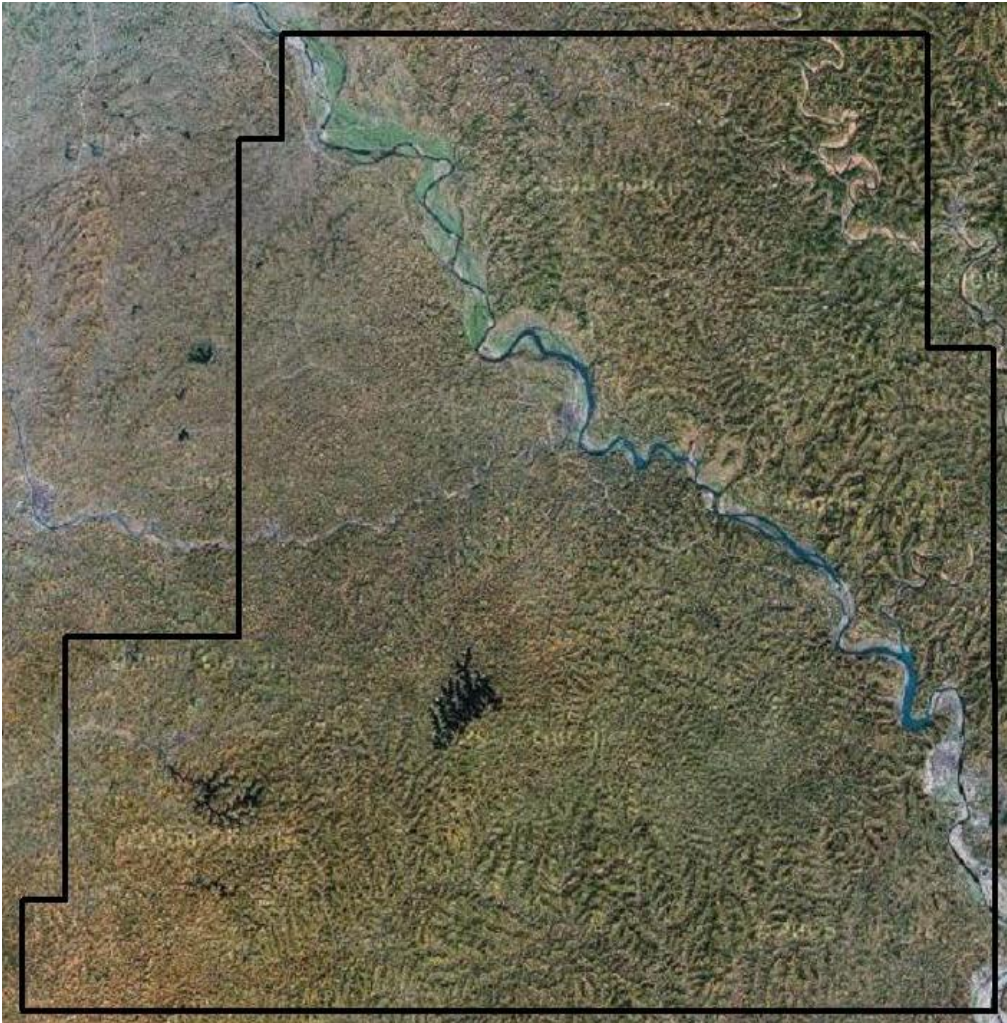
Responsible Unconventional Gas Operating Principles in Practice, Sichuan, China

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Karen Westley
May 8, 2013

Sichuan Basin: Central Shell Block



- Block approx 4,100 km²
- Rugose topography. Incised dendritic drainage.
- Humid Subtropical Monsoonal
- Large anthropomorphic influence
- Densely populated rural area (500-600 persons/km²)
- Economy dominantly rural agricultural. “Bread basket” of China.
- Large part of adult populace are absent as migrant laborers.
- Multiple levels of government: Village, Township, County, Prefecture, Province, National.

Sichuan Basin: Operational Challenges

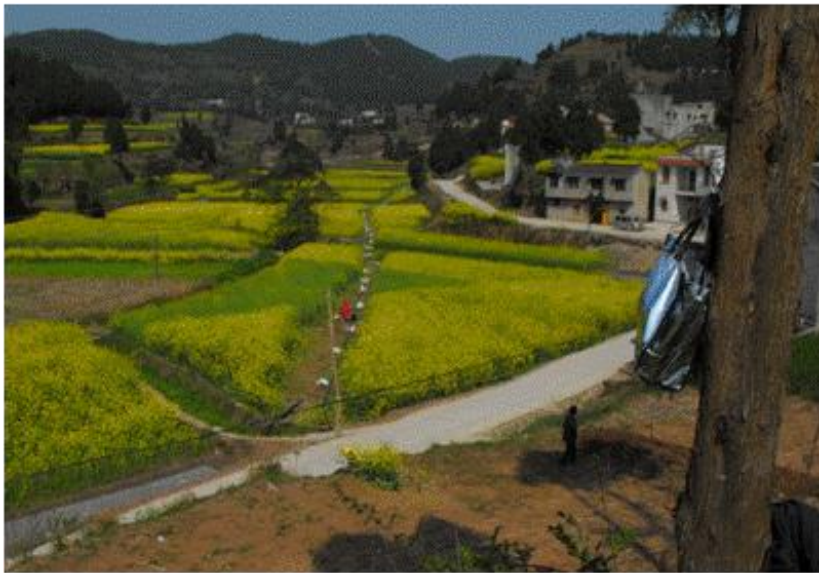


- Operating presents unique challenges. Both Technical & Non-technical
- High potential impact of operations on local communities.
- Drilling many wells from scores of multi-well pads will place stresses on the host communities:



- Proximity of residences to pads.
- Transfer of land from agricultural use.
- Loss of economic livelihood & physical displacement.
- Infrastructure wear from heavy vehicle traffic.
- Water needs & water quality.
- Generation of waste products.

Sichuan Basin: Operating in Proximity to Communities



Shell and Tigt Gas: The Five Core Onshore Operating Principles



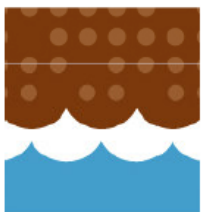
Safety & Well Integrity

Shell designs, constructs and operates wells and facilities in a safe and responsible way.



Footprint

Shell works to reduce its operational footprint.



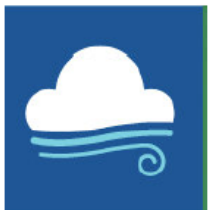
Water

Shell conducts its operations to protect groundwater and reduce water use as reasonably practicable.



Community

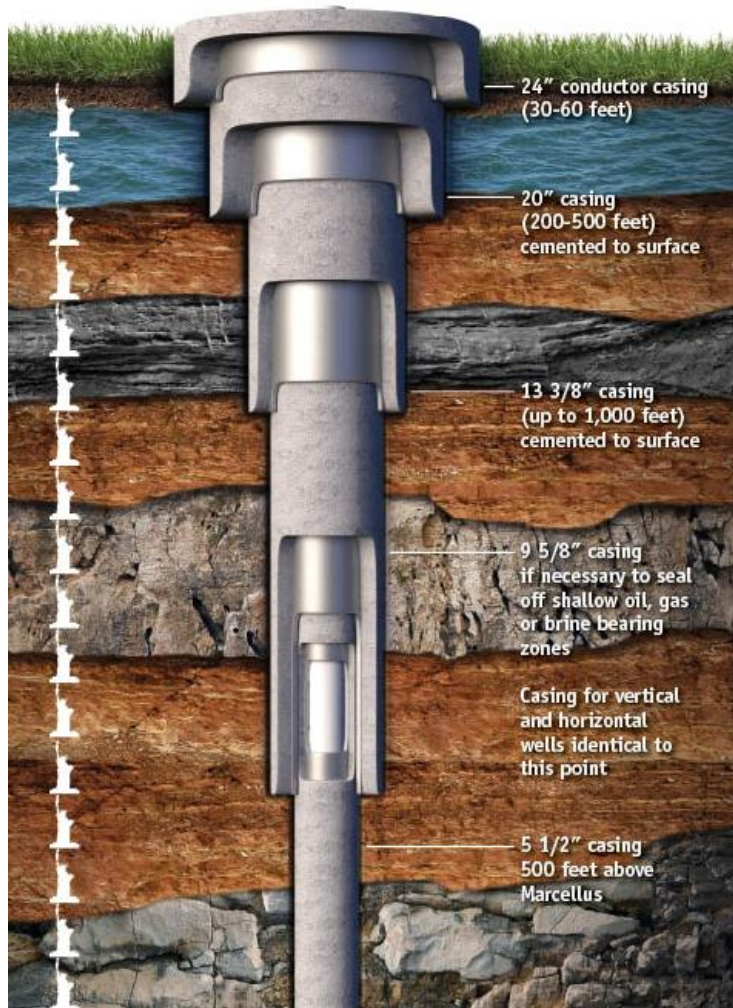
Shell engages with local communities regarding socio-economic impacts that may arise from our operations.



Air

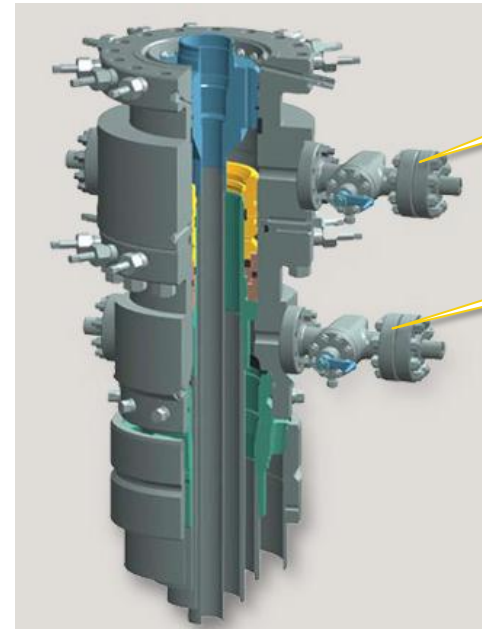
Shell conducts its operations in order to protect air quality and control its fugitive emissions.

Safety and Well Integrity



www.marcelluscoalition.org

Courtesy of Range Resource



A -Annulus Pressure

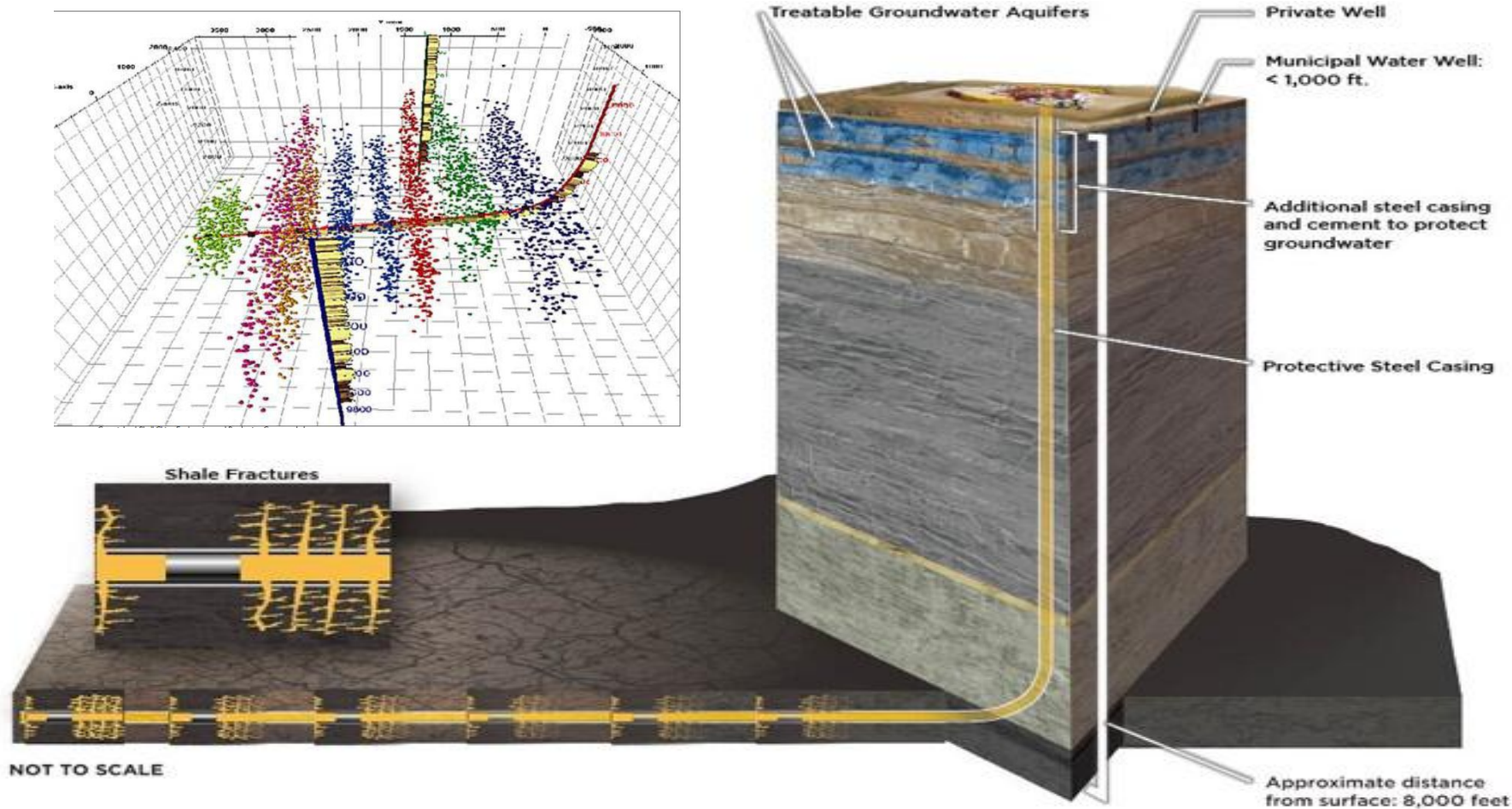
B -Annulus Pressure



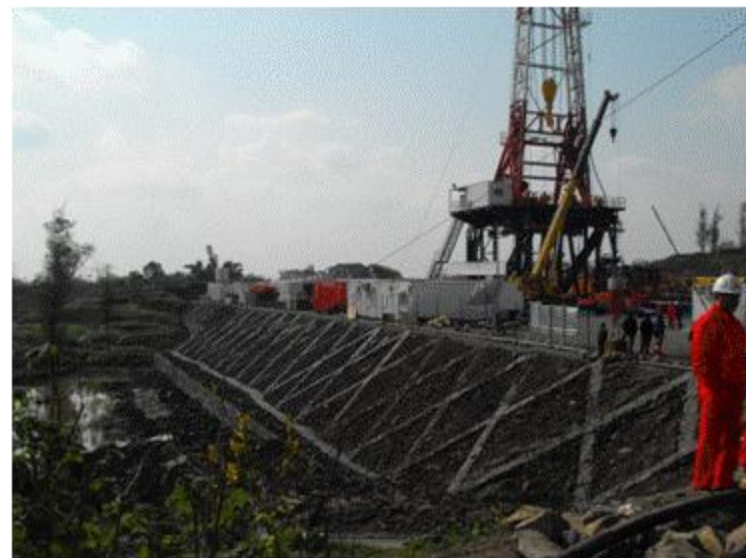
A -Annulus Pressure

B -Annulus Pressure

Safety and Well Integrity



Water: Operating Proximity



Water: Baseline Monitoring



- Detailed environmental baseline monitoring prior to operations at all sites.
- Continuous surveys during/post operations.
- Close Liaison with residents, government and the EPB during operations.
- Respond promptly and proactively to any potential concerns.

Water: Baseline Monitoring

Regular parameters:		Organics:	Metals:		Radioactivity (Bq/L)
Water Temperature	Br	TOC	Mg	Hg	Gross α-Radioactivity
pH	NO ₃ -N	Methane	Boron (B)	Be	Gross β-Radioactivity
DO	NO ₂ -N	Oil and Grease	Fe	Cd	Soil Parameter: pH Ni Cr ⁶⁺ As Fe Total Cr Mn Se Pb TRE Zn TDS Cd Oil & Grease Cu Hg Be Ba
COD _{Mn}	SS	LAS	Zn	Sr	
COD _{cr}	Total Cl	BTEX	K	Se	
BOD ₅	Br	Volatile phenol	Cu	Ag	
NH ₃ -N	TDS	Aldehydes	Cr ⁶⁺	Ca	
NO ₃ -N	Sulfide	Alcohols	Total Cr	Ba	
NO ₂ -N	Sulfate		Pb		
SS	Si		As		
Total Cl			Ni		

Water: Zero Release at Sites/ Closed Loop



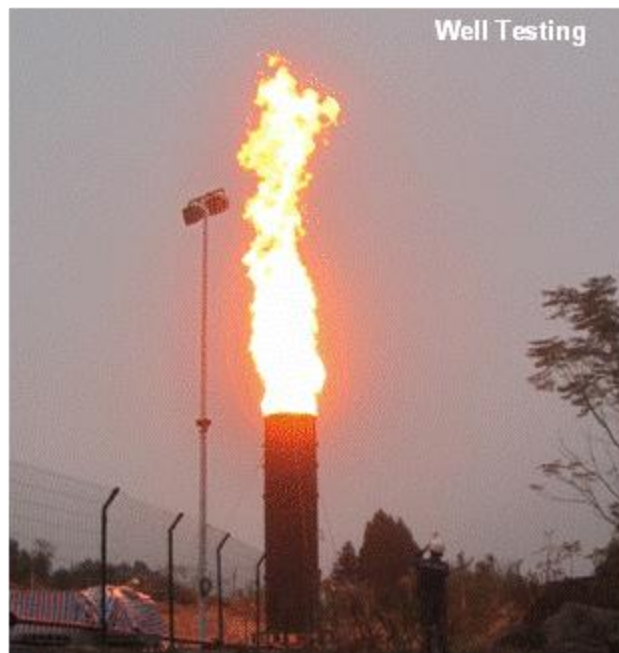
Water: Fluid Inventories

Well			WELL A				WELL B			WELL C			
Stage #			1	2	3	4	1	2	3	1	2	3	
Zones			Xu 2	Xu 2	Xu 4	Xu 4	Xu 2	Xu 2	Xu 4	Xu 2	Xu 4	Xu 4	
Stimulation			Prop Frac	Prop Frac	Prop Frac	Prop Frac	Prop Frac	Prop Frac	Prop Frac	Prop Frac	Prop Frac	Prop Frac	
Job Volume (m³)	Acid, m³	Mixed	12.0	12.0	6.0	6.0	12.0	12.0	12.0	12.3	12.3	12.1	
		Pumped	10.8	12.0	6.0	6.0	12.0	12.0	12.0	12.3	12.3	12.1	
	Gel, m³	Mixed	689.0	505.0	579.0	579.0	734.0	689.0	734.0	459.0	367.0	367.0	
		Pumped	338.0	374.0	504.0	531.0	670.0	620.0	658.0	428.0	369.0	376.0	
	Slick Water, m³	Mixed	505.0	658.0	0.0	413.0	138.0	367.0	321.0	275.0	413.0	92.0	
		Pumped	343.5	370.0	0.0	325.0	101.0	386.0	246.0	223.0	260.0	260.0	
	Total, m³		Mixed	1,206.0	1,175.0	585.0	998.0	884.0	1,068.0	1,067.0	746.3	792.3	471.1
			Pumped	692.3	756.0	510.0	862.0	783.0	1,018.0	916.0	663.3	641.3	648.1
Gel	J580 (kg)	Added	2,875.9	2,107.9	2,416.8	2,416.8	3,063.8	2,875.9	3,063.8	1,915.9	1,531.9	1,531.9	
		Pumped	1,410.8	1,561.1	2,103.7	2,216.4	2,796.6	2,587.9	2,746.5	1,786.5	1,540.2	1,569.4	
	F108 (Liters)	Added	1,371.5	1,005.2	1,152.5	1,152.5	1,461.0	1,371.5	1,461.0	913.6	730.5	730.5	
		Pumped	672.8	744.5	1,003.2	1,057.0	1,333.6	1,234.1	1,309.8	851.9	734.5	748.4	
	L064 (Liters)	Added	362.3	265.5	304.5	304.5	386.0	362.3	386.0	241.4	193.0	193.0	
		Pumped	177.7	196.7	265.0	279.2	352.3	326.0	346.0	225.1	194.0	197.7	
	L010 (kg)	Added	996.3	730.3	837.3	837.3	1,061.4	996.3	1,061.4	663.7	530.7	530.7	
		Pumped	488.8	540.8	728.8	767.9	968.9	896.6	951.5	618.9	533.6	543.7	
	J604 (Liters)	Added	452.9	331.9	380.6	380.6	482.5	452.9	482.5	301.7	241.2	241.2	
		Pumped	222.2	245.8	331.3	349.0	440.4	407.5	432.5	281.3	242.5	247.1	
	M002 (kg)	Added	1,811.5	1,327.7	1,522.3	1,522.3	1,929.8	1,811.5	1,929.8	1,206.8	964.9	964.9	
		Pumped	888.7	983.3	1,325.1	1,396.1	1,761.6	1,630.1	1,730.0	1,125.3	970.2	988.6	
	J218 (kg)	Added	362.3	265.5	304.5	304.5	386.0	362.3	386.0	241.4	193.0	193.0	
		Pumped	177.7	196.7	265.0	279.2	352.3	326.0	346.0	225.1	194.0	197.7	
	J475 (kg)	Added	362.3	265.5	304.5	304.5	386.0	362.3	386.0	241.4	193.0	193.0	
		Pumped	177.7	196.7	265.0	279.2	352.3	326.0	346.0	225.1	194.0	197.7	
Slick Water	J313 (Liters)	Added	66.4	86.5	0.0	54.3	18.1	48.2	42.2	36.2	54.3	12.1	
		Pumped	45.2	48.6	0.0	42.7	13.3	50.7	32.3	29.3	34.2	34.2	
	F108 (Liters)	Added	265.5	346.0	0.0	217.2	72.6	193.0	168.8	144.6	217.2	48.4	
		Pumped	180.6	194.6	0.0	170.9	53.1	203.0	129.4	117.3	136.7	136.7	
	L064 (Liters)	Added	265.5	346.0	0.0	217.2	72.6	193.0	168.8	144.6	217.2	48.4	
		Pumped	180.6	194.6	0.0	170.9	53.1	203.0	129.4	117.3	136.7	136.7	
Bactericide / Biocide	M275 (kg)	Added	203.0	116.0	77.0	99.0	110.0	99.0	126.5	88.0	66.0	77.0	
		Pumped	115.9	74.2	67.0	85.4	97.3	94.3	108.4	78.0	53.2	106.7	
	M290 (Liters)	Added	0.0	0.0	0.0	0.0	0.0	0.0	60.0	5.0	5.0	5.0	
		Pumped	0.0	0.0	0.0	0.0	0.0	0.0	53.0	4.6	4.6	5.6	
Proppant (MT)	100 mesh	Pumped	0.0	10.0	5.0	10.0	5.0	0.0	0.0	6.3	5.8	5.8	
	40/70 C		14.6	25.0	0.0	25.0	0.0	11.2	15.0	3.0	7.6	4.5	
	20/40 C		93.4	51.0	73.0	105.0	140.0	44.4	112.0	112.0	46.8	100.3	
	20/40 RCP		5.4	3.0	15.0	15.0	1.0	14.0	0.0	0.0	0.0	0.0	
	Total		113.4	89.0	93.0	155.0	146.0	69.6	127.0	121.3	60.2	110.6	





Air Quality: Flaring NOT Venting





Air Quality: Flaring NOT Venting





Air Quality: Context



Footprint



- We carefully select and design our appraisal sites to avoid resettlement and utilize existing topography.
- Land is acquired on a temporary basis and either reclaimed or converted to permanent acquisition once a gas well is to be tied-in.
- Pad sizes in Sichuan are considerably smaller than equivalent well sites in North America, or even in Changbei.
- Future development pads will contain more wells per pad, but will continue to use these principles.

Footprint: Reduced Lease Size



Shell Dual Cellar Well Pad, Sichuan



Satellite Image: 20-Well Montney Cluster ,Canada



Footprint: Minimize Impact



Dual Cellar Well Site,

Footprint: Minimize Impact



Dual Cellar Well Site,

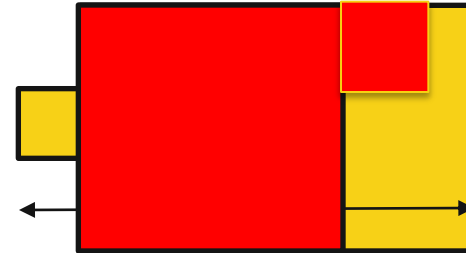
Footprint: Utilize topography and existing infrastructure



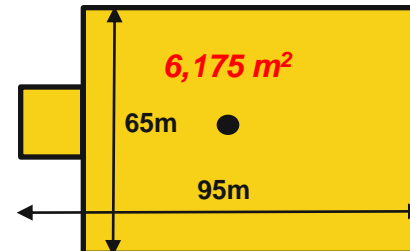
Footprint: Utilize topography and existing infrastructure



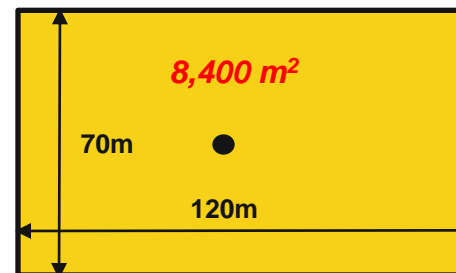
Footprint: Rapid Restoration



Current Sichuan Appraisal Dual Well Pad Size.

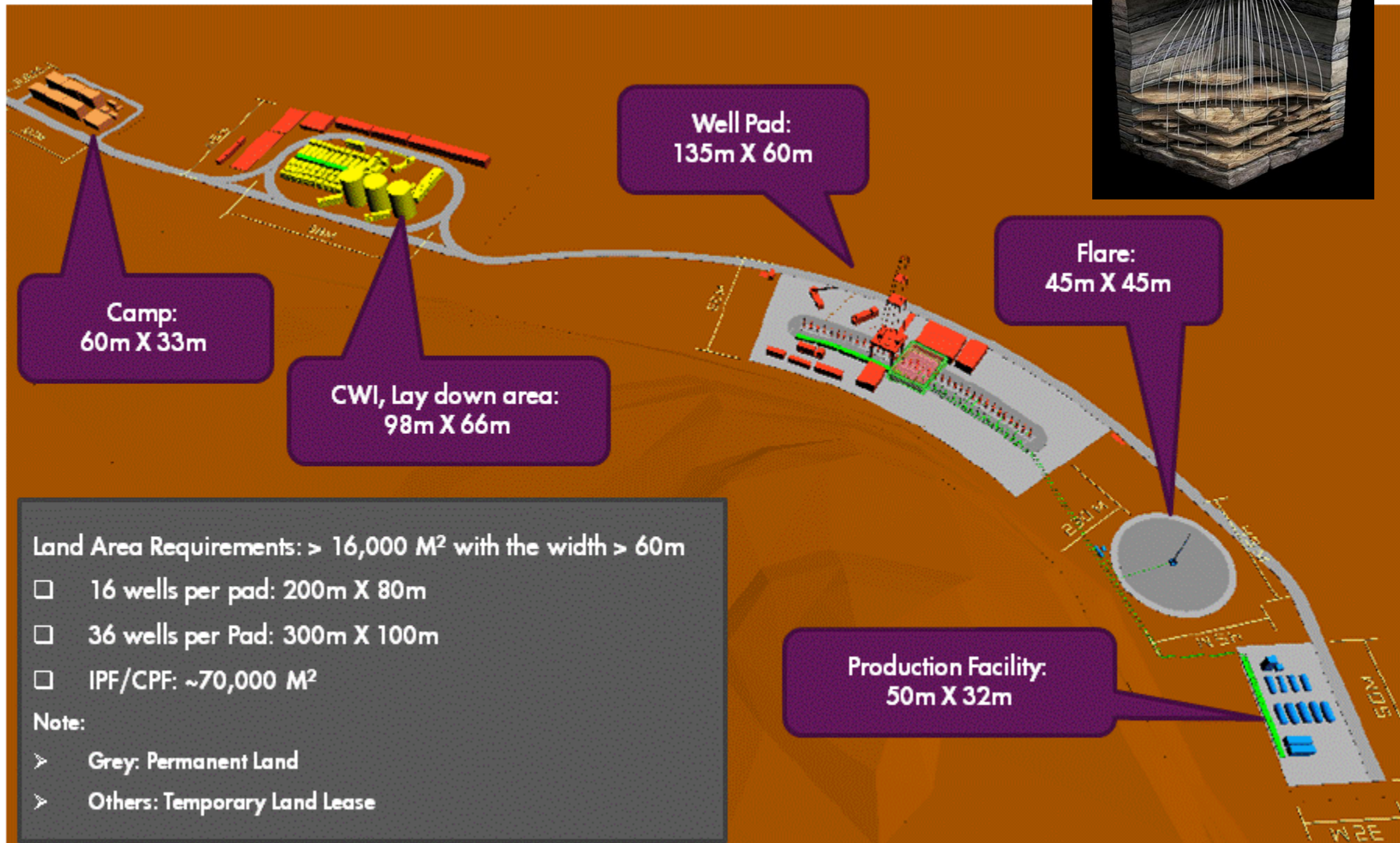


Reduced Sichuan Lease Size.



Initial Sichuan Exploration/Appraisal Lease Size.

Footprint: Future Development Pads





Community: People are Empowered



IPTC-16859 Responsible Unconventional Gas Operating Principles in Practice, Sichuan, China. Anthony Cortis



Community: Close Relationships



- Liaise closely with residents, and Government wrt operations and their impacts.
- Maintain live community grievance/engagement registers at all sites.
- Full-time community liaison teams infield. Budget has tripled in 3 years.
- Respond promptly to all issues and track them till closure.
- Operate on a policy of minimal impact to the community.
- Promptly repair any damage.



Community: Frequent Engagement and Consultation





Noise and Vibration

- EPB requires noise monitoring on site
 - to verify legal compliance
 - or required to pay discharge fees and compensation payments.
- Measurements taken but not completed consistently. Noise monitoring handed over for each location in the same way as the community register is.
- For each operation identify main noise sources that may or may not be in operation at the time. Utilize readings to improve noise management
- The process allows confirmation of compliance
- Also allows identification to what extent we are liable to pay compensation by generating maps of the noise exposure for each operation.
- Boundary limits are defined under law, - not required to pay compensation to farmers outside these limits.



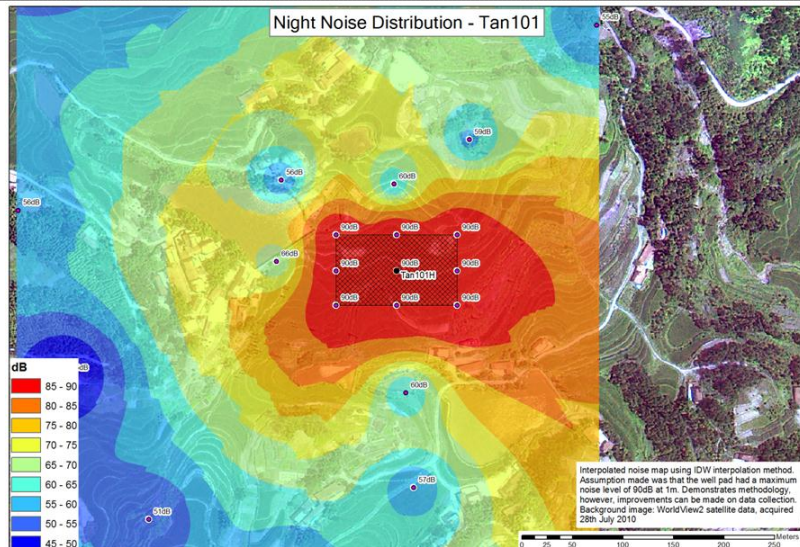
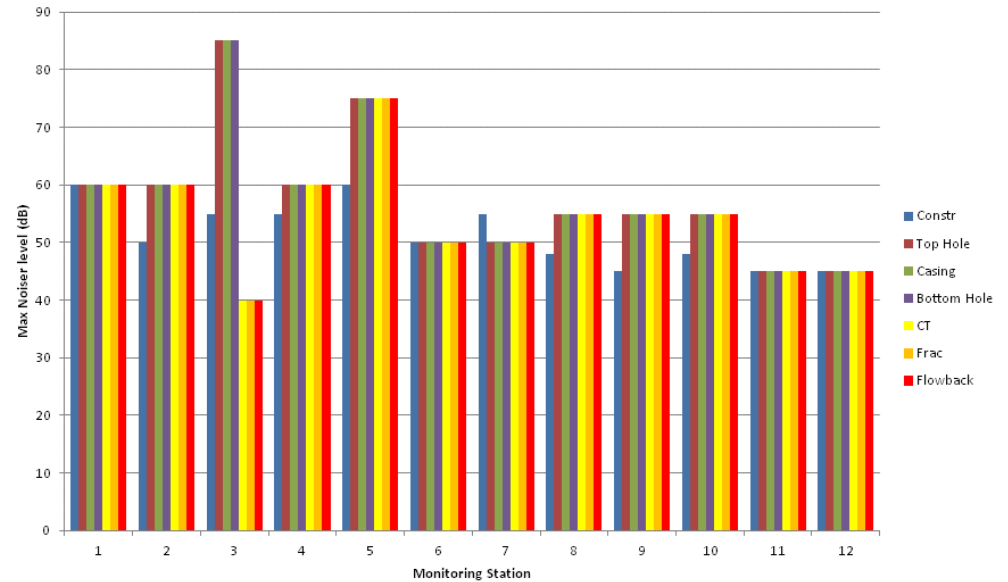
Noise and Vibration

(Wellname) Location Noise Monitoring



Location Number	Description
1	Located on the west side at the entrance to the rig site
2	Located on the NW corner of the rig site
3	Located on the NE corner of the rig site
4	Located on the SW corner of the rig site
5	Located on the SE corner of the rig site
6	Located on the "T" junction of the road to the south of the rig pad
7	House on the East side of the location.
8	House located NE of the location dur north of location 7
9	House located on the Southern side of the valley
10	Building located on the Western side of the well pad
11	Farm on SW side o fhfte location
12	Farm east of the location

JQ Noise Monitoring Well -X





Noise and Vibration



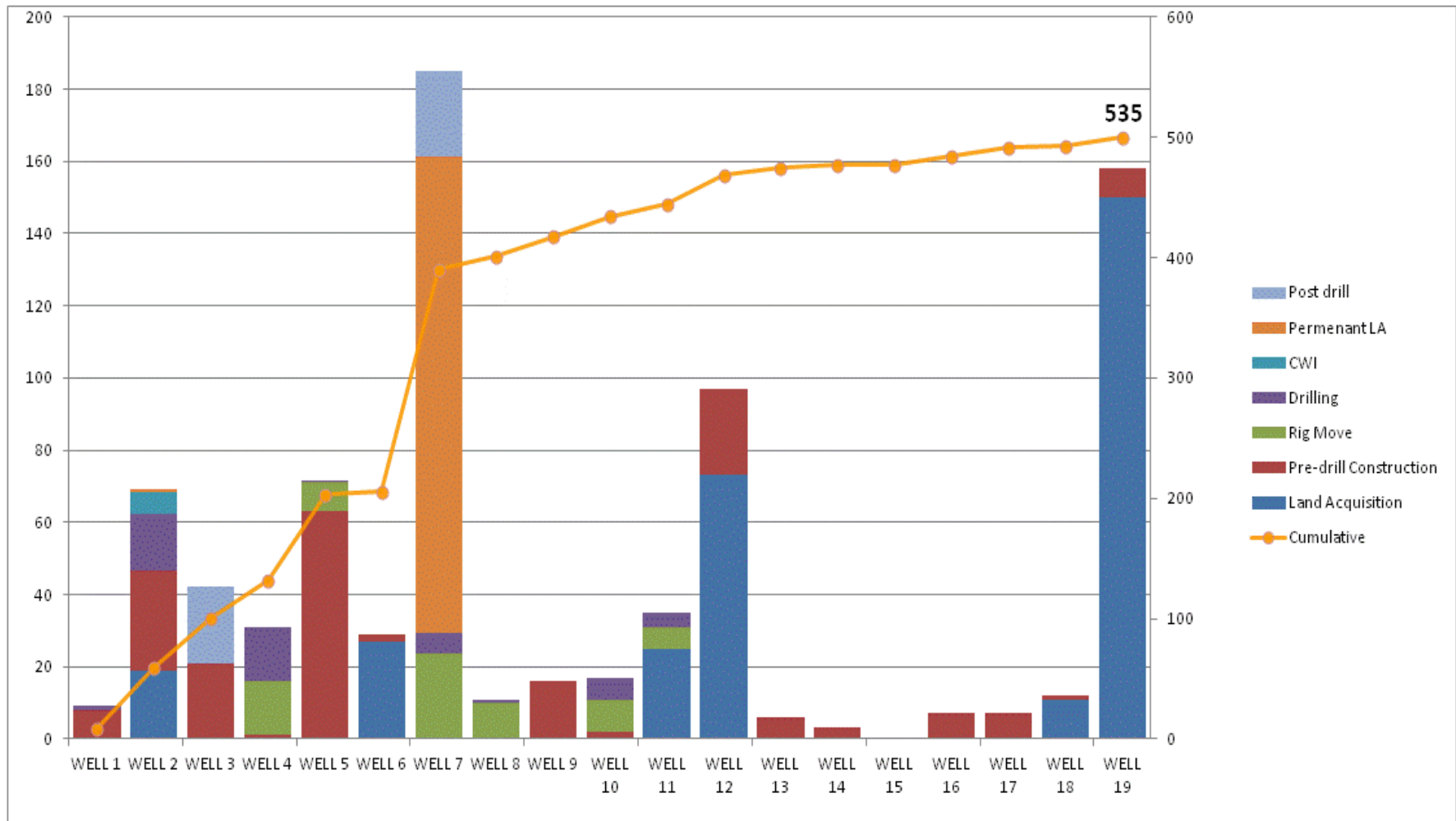


Community: Frequent Engagement and Consultation





Community: Impact on Project





Community: Upgrade Local Infrastructure



Village Access Road Upgrade.



Village Access Road Upgrade.

Bridge Upgrade





Community: Employment and Community Content



Security guard



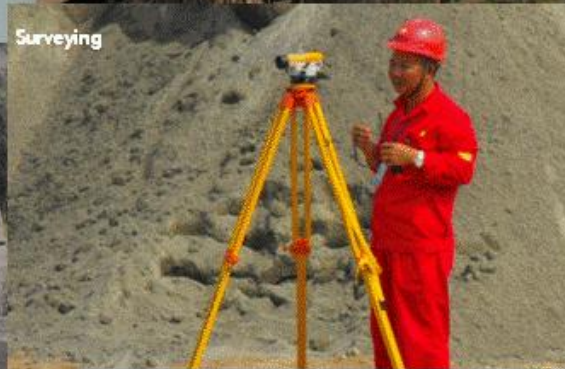
Catering and accommodation



Using small business · economic cascade



Villagers quarrying stone for road.



Surveying



Local labor for construction crews.



Trucking / Logistic support



Construction and subcontracting



Camp support · Local cooks / cleaners

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Community: Positive Feedback



Responsible Operations: Success Factors

- Implementation of the 5 Onshore operating principles through a learning-by-doing approach - based on technical innovation & innovation in approach to management of environmental and social risks. Adapt to unique challenges in Sichuan.
- Adaptive management and integration of 'technical' and 'non-technical' solutions to challenges presented by subsurface and surface factors.
- Close collaboration with partner, contractors and national and provincial regulators and government authorities.
- Application of best practices from Shell operations around the world.
- Leadership in setting expectations and encouraging behaviors that lead to innovation and problem solving .
- Early identification and proactive response to community concerns.
- Place the right resources at the community/operational fence-line to address community concerns promptly and in a transparent manner.

